

**Junction structure for connecting two profiles in a vehicle support frame**

The invention relates to a junction structure for connecting two profiles, in particular in a vehicle support frame, the first profile of which has at least two planar, parallel sides and the second profile consists of two parallel, opposite girders and at least one strip, connecting the girders, whereby the girders with their lateral ends project relative to the strip, these projections forming paired parallel flanges.

For some years particularly in the construction of vehicles before the background of new lightweight construction concepts, hollow profiles, that is to say profiles with a closed cross section, are again increasingly being used. In particular such hollow profiles, which are produced from high and maximum strength steel materials, offer a high weight reduction potential. A central problem area in the use of hollow profiles concerns their joining together by means of connecting junctions.

Junction structures for connecting profiles, in particular hollow profiles, have been known for a long time. Thus European Patent EP 0 568 251 B1 describes a T-shaped junction structure for joining a cross member configured as a hollow profile with a rectangular cross section to the side rocker rail. In accordance with one embodiment of such a T-junction the cross member at its one end is split lengthwise and bent up so as to form two profiles with C-shaped cross section, arranged flush with one another, bent about 90° in each case, against which the side rocker rail is placed and welded thereto. As a result a junction structure with a large contact zone and high strength associated therewith can be realised, which in addition provides tolerance compensation in the vehicle longitudinal direction, however linked with this is the comparatively high production cost due to the respective need for individual working of the cross member end. Also, in the event of a front or rear collision, that is to say if force is applied to the vehicle frame in the longitudinal direction, the weld seam can tear, whereby the connection between cross member and side rocker rail is completely broken and the vehicle support frame to a large extent loses strength.

A junction structure in a vehicle support frame described in the German Patent DE 196 53 509 AI is based on a junction element with at least two connection pieces produced from sheet steel by hydro-forming (IHU). The hollow profiles to be connected are attached to the connection pieces and fixed by means of welding or bonding. Although this permits precise connection of two or several profiles, whereby some degree of tolerance compensation is provided through a limited variable insertion depth, such a junction element can only be produced individually and as a result of the IHU technology is very costly.

Finally a junction structure for connecting two profiles in accordance with the preamble is known from practice, whereby the strip(s) of the second profile connecting the girders are cut lengthwise relative to the girders, so that the frontal projections of the girders resulting therefrom enclose the first profile connected at right angles in a form fit. This junction structure fixed by means of a weld join is likewise characterised by high strength. However under stress with thin wall thickness and at the same time large profile cross sections, curving effects and/or twisting of the first profile usually configured as a longitudinal member can ensue, whereby the strength of the junction structure is substantially reduced. Moreover the frontal trimming of the second profile means that this cannot be taken from continuous profile production due to the need for intermediate processing, which leads to increased cost. As an alternative to the additional trimming the second profile may also be produced individually, which however is likewise associated with high cost.

Therefore the object of the invention is to create a junction structure of the kind described at the beginning, which permits high-strength connection of the profiles, whereby tolerance compensation of the profiles should be provided, just as the possibility of using profiles directly from a continuous production process.

The object is achieved according to the invention with a junction structure in accordance with the preamble, whereby the first profile at the location of connection has a recess, into which the second profile is inserted on the front side in such a manner that the parallel sides of the opposite ends of the first profile limiting the recess, rest in a form fit against the insides of the opposite flanges of the second profile and are connected thereto.

The junction structure according to the invention is simply configured and thus is to be produced without high production cost. It is particularly advantageous that the second profile can be taken directly from continuous production and only needs to be cut to length as required by the user. In contrast to the prior art therefore frontal trimming of the strip is not necessary.

It is proposed according to the invention that the second profile is inserted into a recess provided in the first profile in its sidewalls, so that the strip(s) of the second profile project into the junction region. Thus a connecting junction with particularly high strength is created, since if the first profile is longitudinally stressed the inserted section of the strip(s) acts as a bulkhead steel plate and thus reinforces the junction. As a result both a cross-sectional change of the profiles is suppressed when heavily stressed and their twisting in the vicinity of the junction is effectively prevented.

Tolerance compensation of the profiles is possible in two dimensions. This can be realised in the longitudinal direction of the first profile by a variation in the width of the recess as well as by a variation in the situation of the inserted second profile perpendicularly to the direction of insertion, so that the ends of the first profile are arranged at a different distance from the strip(s) of the second profile.

On the other hand tolerance compensation can also be realised in the longitudinal direction of the second profile, that is to say by a variation in the insertion depth of the second profile into the recess provided in the first profile.

Preferably the second profile is a DAVEX profile. DAVEX profiles for production reasons already have the necessary cross sectional geometry with the parallel flanges projecting laterally outwards. The thickness ratio between the girders and the strip(s) can be easily adjusted according to the load profile of the later application. In contrast to an extruded press section for example, DAVEX profiles can be produced problem-free from high-strength or maximum strength steel materials. In this case the use of different materials for the girders and the strip(s) respectively is also possible, so that the girders, possibly particularly loaded in operation, can be produced from a high-

strength material, while the less loaded strips can be produced from a more economical material.

Expediently the profiles are joined by welding. As a tangible embodiment of this weld join a linear weld seam is particularly appropriate, as a result of which the outer edges of the parallel flanges of the second profile are connected to the sides of the first profile resting in a form fit. An elongated weld seam is achieved by such a linear weld join, which additionally contributes to the high strength of the junction structure.

The use of the junction structure according to the invention is particularly advantageous for connecting junctions of profile elements in a vehicle support frame. Expediently in this case the first profile is configured as a vehicle longitudinal member, in particular as a rear vehicle longitudinal member, and the second profile as a vehicle cross member. The girders of the second profile with their flanges pointing outwards offer a suitable contact surface for components of the vehicle floor, for example.

In the event of a rear collision, during which heavy force is applied on the front side to the rear longitudinal member, the junction does not lose its stability due to the strips projecting into the first profile and sealing off the profile ends, even if tearing of the weld seams occurs.

Apart from use in the support frame of motor cars the junction structure according to the invention is also particularly suitable for use in buses, commercial and rail-mounted vehicles, since these generally have a ladder frame as a basic structure.

If the second profile concerns a DAVEX profile, this is particularly suitable as a vehicle seating support, that is to say as cross member on which vehicle seats - in a motor car or a bus - can be bolted. Here the fact that a load, acting perpendicularly on the girder surface, through a person sitting in the vehicle for example, can be absorbed especially well by the DAVEX profile is exploited.

The junction structure with regard to the recess provided in the first profile can be constructed in various ways. Thus according to a first alternative the first profile can

be completely split at the location of connection. In this configuration tolerance compensation is possible in the longitudinal direction of the first profile in a particularly simple way. Slight cross misalignment of the profile halves arranged flush with one another is also possible.

According to a continuing embodiment the one end of the first profile, completely split on the side turned away from the second profile, has a projection by which it is connected to the other end of the first profile. On the one hand this configuration can provide tolerance compensation in the longitudinal direction of the first profile. On the other hand the junction structure is additionally reinforced by the projection of the one profile end, if the second profile is stressed in its longitudinal direction.

With another alternative embodiment of the junction structure according to the invention, it is proposed that the first profile is not completely split at the location of connection, but only as far as a strip arranged on the side turned away from the second profile. The first profile therefore in contrast to the embodiment described above has a continuous thread, as a result of which the fatigue resistance of the junction structure is increased. Furthermore the junction structure is also particularly effectively reinforced by the remaining strip if the second profile is heavily stressed in its longitudinal direction, for example in the event of a side collision.

In accordance with a further advantageous embodiment of the invention the second profile has two strips, the one of which is cut lengthwise. In detail with this configuration having two strips preferably selected particularly for DAVEX profiles, the one strip is cut lengthwise to such an extent that the recess in the first profile can be selected substantially smaller, and thus the opposite ends of the first profile are supported at a substantially shorter distance from one another. Although this is linked with greater weight of the junction structure and an additional work process (trimming) during the preparation of the second profile, the strength of the junction structure can be substantially increased further. Therefore this embodiment is particularly suitable in applications, which are less weight sensitive, but instead all the more associated with permanently high stresses, for example in the commercial or rail-mounted vehicle field.

Finally the high strength of the junction structure according to the invention, in particular its torsion rigidity, can be increased still further as a result of it being additionally enclosed with shell-type elements, which can be configured as deep-drawn or edge components.

The invention is explained below in detail with reference to a drawing illustrating exemplary embodiments, wherein there is shown:

- Fig. 1            a junction structure for connecting two profiles with a completely split first profile, in perspective view,
- Fig. 2            the junction structure of Fig. 1 in plan view,
- Fig. 3            the junction structure of Fig. 1 in front view in the direction of the arrow III,
- Fig. 4            the junction structure of Fig. 1 in the section along line IV-IV of Fig. 3,
- Fig. 5            the junction structure of Fig. 1 with double tolerance compensation in plan view,
- Fig. 6            the junction structure of Fig. 1 with trimmed second profile in plan view,
- Fig. 7            the junction structure of Fig. 6 in the lateral section along line VII-VII of Fig. 6,
- Fig. 8            the junction structure of Fig. 1, in which as a modification the one end of the first profile has a projection, in perspective view and
- Fig. 9            the junction structure of Fig. 1, in which as a further modification the first profile is split as far as a strip, in perspective view.

The junction structure illustrated in Fig.1 consists of a first profile 1, which is configured as a hollow profile with a rectangular cross section, and a second profile 2, which consists of two parallel, opposite girders 3, 4 and two likewise parallel aligned strips 5, 6, connecting the girders 3, 4, whereby the girders 3, 4 with their lateral ends project relative to the strip(s) 5, 6, these projections forming paired parallel flanges 31, 42, 32, 42. The second profile 2 preferably concerns a DAVEX profile, in which the cross-sectional shape described is already present as a result of the production process. The first profile 1 is split along its total length, so that two opposite profile ends 8, 9, which limit a recess 7, are present. Into this recess 7 the second profile 2 is inserted in such a manner that the upper and lower surfaces 81, 91, 82, 92 respectively of the profile ends 8, 9 rest in a form fit against the insides 31a, 41a, 32a, 42a of the opposite flanges 31, 41, 32, 42 of the second profile 2. On the outer edge of the flanges 31, 41, 32, 42 the second profile 2 is rigidly connected by a total of four weld seams 3a, 4a, which are configured as linear weld seams, to the profile ends 8, 9 of the first profile 1, as a result of which a simply configured, high-strength junction structure with the strips 5, 6 acting as bulkheads for the profile 1 is formed.

As part of a vehicle support frame, whereby the first profile 1 forms a rear longitudinal member and the second profile 2 a cross member for example, the junction structure according to the invention is characterised by very good crash properties. If due to a rear collision very heavy force is applied in the longitudinal direction to the first profile 1 forming the longitudinal member for example, the junction structure does not lose its stability, even though the linear weld seams 3a, 4a tear, since the profile ends 8, 9 are inhibited from moving longitudinally by the strips 5, 6 of the inserted second profile 2 acting as bulkheads and collapsing, that is to say a major cross-sectional change, of the profile ends 8, 9 as well as their excessive torsion is prevented at the location of the junction structure through the flanges formed by the girders 3, 4.

With the junction structure according to the invention, as illustrated in Fig. 5, two-dimensional tolerance compensation of the two profiles 1, 2 is possible. Thus the situation of the second profile 2 can be adjusted perpendicularly to the direction of insertion as tolerance compensation in the longitudinal direction of the first profile 1. In the present case this is selected so that the profile ends 8, 9 are arranged at a

different distance from the strips 5, 6 of the second profile 2. In addition the linear dimension of the first profile 1 can be altered in a limited way by a variation in the width of the recess 7. Also to be seen in Fig. 5, as tolerance compensation in the longitudinal direction of the second profile 2, this is not completely, but only partly inserted into the recess 7.

With the embodiment of the junction structure according to the invention illustrated in Fig. 6 the one strip 6 of the second profile 2 is cut lengthwise in such a manner that the recess in the first profile 1 can be selected substantially smaller and thus the profile ends 8, 9 lie at a substantially shorter distance from one another. Although linked with a greater weight of the junction structure as well as a higher production cost, this makes for a significant increase in the strength of the junction structure.

With the embodiment of the junction structure illustrated in Fig. 8 the one profile end 9, on the side turned away from the second profile 2, has a projection 10 by which it is connected to the other profile end 8. The connection is again configured as linear weld seam 10a. As a result of this configuration the junction structure is additionally reinforced if the second profile 2 is stressed in its longitudinal direction, for example in the event of a side collision.

Finally a further embodiment of the junction structure is illustrated in Fig. 9. Here the first profile 1 is not completely split at the location of connection, but only as far as a strip 11 arranged on the side turned away from the second profile 2. The first profile 1 in contrast to the embodiments described above thus has a continuous thread, as a result of which the fatigue resistance of the junction structure is increased. If the second profile 2 is heavily stressed in the longitudinal direction, the strip 11 acts as barrier, which effectively prevents the second profile 2 being pushed through the recess 7 of the first profile 1, in the event of crash-induced tearing of the weld seams 3a, 4a, for example.